The role of RNA in the ribosomes thus became less significant as attention turned to mRNA as the template and to tRNA as the transport for bringing amino acids to the template. This is ironic, because it was RNA that had been the distinguishing feature of first microsomes and then ribosomes. Research on the ribosomes themselves emphasized instead the proteins that comprised them. Those investigating the proteins in ribosomes deployed the same strategy as those investigating the mitochondrion: That is, they attempted to decompose the ribosome into different component parts. The particles separated in a centrifuge are often reported in terms of the time required for sedimentation, measured in terms of Svedberg units (one $S = 10^{-13}$ seconds); longer times correspond to lighter weights. Separating microsomes from yeast cells, Fu-Chuan Chao and Howard Schachmann (1956) reported 80S microsomes, which in turn dissociated into 60S and 40S units unless a trace of magnesium was present. (Svedberg units are not additive because the rate of sedimentation is affected by both the mass and shape of the particle.) Mary Petermann and her collaborators (Petermann et al., 1958) found that 78S liver ribosomes decomposed into 62S and 46S units. Finally, working with *Escherichia coli*, Alfred Tissiéres and James Watson (Tissiéres & Watson, 1958; Tissiéres et al., 1959) identified 70S ribosomes that separated into 50S and 30S units. From these studies, it appeared that ribosomes generally were comprised of two subunits of slightly different sizes, referred to as large and small subunits. Electron micrographs by Palade and his collaborators subsequently provided independent evidence for the two subunits of the ribosome (Sabatini, Tashiro, & Palade, 1966).

Research on the mechanism of protein synthesis involved not just the decomposition of the system into separate types of RNA and decomposition of the ribosome itself into subunits comprised of different forms of ribosomal RNA and protein, but also research on how these parts were organized. One important clue as to the organization of the parts stemmed from theoretical speculation about the relative size of messenger RNA molecules and ribosomes. Alexander Rich, a professor of biophysics at MIT, noted that the messenger RNA would be 1,500 Å or more in length, whereas ribosomes were only about 230 Å in diameter. Although messenger RNA chains might be wrapped around the ribosome, Rich concluded this was unlikely because then it would be difficult to maintain appropriate contact between messenger RNA and the ribosome. As Rich reported, "It occurred to us that proteins might actually be made on groups of ribosomes, linked together somehow by messenger RNA" (Rich, 1963, p. 45; see also Warner, Knopf, & Rich, 1963). As he described it, "the protein 'factories' of the cell are not single ribosomes working in isolation, but collections of ribosomes working together in orderly